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THREE NEW SPECIES OF CILIATE IN THE GENERA *PSEUDOCOHNILEMBUS, PLEURONEMA,* AND *UROTRICHA* (CILIOPHORA)

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Abstract.—The morphological and biometric characteristics are given for three new species of freshwater ciliates: two of them belonging to the order Scuticociliatida (*Pseudocohnilembus fluviatilis* and *Pleuronema ovata*) and one to the order Prorodontida (*Urotricha rotunda*). *P. fluviatilis* is especially distinguished by the presence of an inner oral membrane consisting of six clearly differentiated kinetosomal segments. *P. ovata* shows a reduced oral infraciliature with an anterior membrane and two posterior membranoid segments, as well as a paroral membrane. In this species, there is an area in "V," located near the posterior pole, where several dorsal kineties converge. *U. rotunda* is characterized by the number and composition of the caudal kinetosomic groups and of the brush kineties. The taxonomic placement of these species is discussed.

A number of species in the genera *Pseudocohnilembus* and *Pleuronema* have been described. Apart from the outstanding work of Evans & Thompson (1964) and Thompson (1966a, 1966b) on *Pseudocohnilembus* further, more recent, descriptions have been made, including those of Foissner & Wilbert (1981), Fernandez-Leborans & Castro de Zaldumbide (1984) and Foissner (1985). Morphogenesis within this genus has been dealt with by Evans & Corliss (1964) and Fernandez-Leborans & Castro de Zaldumbide (1986a). Dragesco (1960, 1968) presented some early descriptions of silver-stained *Pleuronema* material, followed more recently by Dragesco & Dragesco-Kernéis (1986), Agamaliev (1983), Grolière & Detcheva (1974), and Small & Antipa (*Pleurocoptes,* 1978). Dragesco (1960), Foissner (1979, 1983, 1984), Alekperov (1983), Pätsch (1974), Martin-Gonzalez et al. (1985) and Muñoz et al. (1987, 1989) provided descriptions of various species in the genus *Urotricha.*

Throughout these studies the morphological and morphogenetic features of various species in these genera have been described, a noticeable evolution having been observed with respect to the significance of certain structures, such as the infraciliature of *Urotricha* (Muñoz et al. 1989). On the other hand, the number of new species described has been slowly increasing, due to the contributions of Martin-Gonzalez et al. (1985) (*U. vitrea*), Muñoz et al. (1987) (*U. nais*), Muñoz et al. (1989) (*U. ondina*) and Song & Wilbert (1989) (*U. corlissiana* and *U. valida*), and it would be necessary to carry out a comparative analysis of the known species and then determine which characteristics and which order of biometric variability, serve to differentiate the species. In addition, further biometric and statistical studies of each species are necessary, their scarcity contrasting greatly with the large number of morphological descriptions. These aspects, among others, are considered here.

Methods

The samples containing the ciliates studied were collected from three areas from the

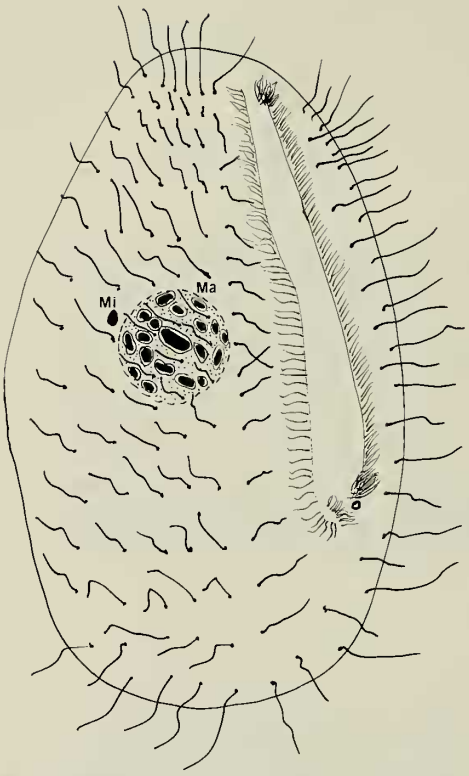


Fig. 1. *Pseudocohnilembus fluviatilis*. General view showing the cilia and the nuclear components.

outskirts of Madrid (Spain). *Pseudocohnilembus* species were found in samples from the Navacerrada reservoir (48 km, NW of Madrid, 4°00′W, 40°45′N); *Pleuronema* species were found in the Guadarrama river at the village of Villalba (4°00′W, 40°35′N, 39 km of Madrid); *Urotricha* species were collected in the reservoir at La Jarosa (60 km of Madrid, 4°10′W, 40°12′N). The ciliates were fixed with 2% OsO4 to preserve them for general biometric measurements. Some of each samples were stained with the silver carbonate impregnation technique (Fernandez-Leborans & Castro de Zaldumbide 1986b) in order to obtain permanent slides and photomicrographs. The statistical treatment of the biometric data was carried out using the Statgraphics program. The terminology used in the different descriptions corresponds to that defined by Lynn (1988).

Results

Pseudocohnilembus species

General morphology.—The ciliates are oval in shape, 33–36.2 μm in length and 24–27 μm in width. They have a spherical or slightly oval macronucleus with a length of 12.6–14.4 μm and a width of 10.8–13.7 μm and a single spherical micronucleus, 3–3.8 μm in diameter (Fig. 1, Table 1).

Somatic infraciliature.—There are 8 ventral kinetics, each one possesses 15–17 pairs of kinetosomes. On the dorsal side there are 8–9 kineties, each with 15–16 pairs of kinetosomes. Each pair of kinetosomes of the somatic kineties show three types of derivatives: 1) an anterior one extends from the right kinetosome of each pair towards the anterior right area of the ciliate (kinetodesmal fibril) and is 1.51–1.61 μm in length; 2) a posterior one extends from the right kinetosome of each pair towards the posterior right area of the ciliate (postciliary microtubules) and is 0.66–0.72 μm in length; and 3) a derivative extends from the left kinetosome of each pair to the anterior left area of the ciliate (transverse microtubules) and is 0.48–0.51 μm in length (Figs. 2, 3 and 4; Table 1).

Oral infraciliature.—The oral area extends from near the anterior pole of the ciliate to ⅔ of the body length. The undulating membrane or paroral formation (PF, Fig. 2) is 16.8–18.5 μm in length; its posterior end is 11.88–13.2 μm from the posterior pole and 24.6–25.8 μm from the anterior pole of the ciliate. It is made up of 54–56 dikinetids that curve round in the posterior area near the cytostome.

On the left side of the oral area is located the inner membrane (IM) consisting of six kinetidal structures that are described in order, from the anterior pole of the ciliate. 1) *a1* is a group of 8–9 kinetosomes, 1.2–1.4 μm long and about 1.6 μm wide. 2) *a2* is a

Table 1.—Biometric characteristics of *Pseudocohnilembus fluviatilis*.

	Arithmetic mean	Standard deviation	Standard error	Coefficient of variation	Pearson coefficient	Minimum	Maximum	Observations
Length	34.80	0.78	0.08	2.24	−0.25	33	36.2	80
Width	25.53	0.83	0.09	3.25	0.63	24	27	80
Length of the macronucleus	13.40	0.59	0.06	4.40	0.67	12.6	14.4	80
Width of the macronucleus	11.89	0.78	0.08	6.56	−0.39	10.8	13.7	80
Diameter of the micronucleus	3.39	0.22	0.02	6.48	−0.44	3	3.78	80
Number of ventral kineties	8.00	0.00	0.00	0.00	0.00	8	8	80
Number of dorsal kineties	8.33	0.49	0.05	5.88	0.67	8	9	80
Length of the paroral formation	17.36	0.51	0.05	2.93	0.31	16.8	18.5	80
Length of a1 (inner membrane)	1.25	0.04	0.00	3.20	0.71	1.2	1.35	80
Width of a1	1.58	0.01	0.00	0.63	0.31	1.56	1.62	80
Length of a2 (inner membrane)	9.84	0.15	0.01	1.52	0.29	9.6	10.1	80
Length of a3 (inner membrane)	1.11	0.03	0.00	2.70	0.66	1.08	1.2	80
Width of a3	0.71	0.04	0.00	5.63	0.25	0.6	0.82	80
Length of a4 (inner membrane)	3.37	0.01	0.00	0.41	−0.69	3.36	3.4	80
Width of a4	1.08	0.01	0.00	0.92	0.33	1.07	1.13	80
Length of a5 (inner membrane)	4.20	0.09	0.01	2.14	0.04	4.14	4.5	80
Width of a5	1.17	0.02	0.00	1.70	0.45	1.13	1.21	80
Length of a6 (inner membrane)	4.28	0.17	0.01	3.97	0.47	4.18	4.82	80
Width of a6	0.82	0.04	0.00	4.87	0.48	0.78	0.92	80
Distance posterior end of paroral–anterior pole	25.03	0.30	0.03	1.19	0.12	24.6	25.8	80
Distance posterior end of paroral–posterior pole	12.18	0.43	0.04	3.53	0.18	11.88	13.2	80
Distance a5–anterior pole	21.00	0.65	0.07	3.09	−0.14	20.1	22.8	80
Distance a5–posterior pole	14.96	0.24	0.02	1.60	0.65	14.7	15.6	80
Number of kinetosomes of the paroral	54.50	0.79	0.08	1.44	0.63	54	56	80
Number of kinetosomes of a1	8.16	0.38	0.04	4.65	0.42	8	9	80
Number of kinetosomes of a2	36.66	0.98	0.10	2.67	0.67	36	38	80
Number of kinetosomes of a3	5.16	0.38	0.04	7.36	0.42	5	6	80
Number of kinetosomes of a4	8.83	0.93	0.10	10.53	0.89	8	10	80
Number of kinetosomes of a5	10.50	0.79	0.08	7.52	0.63	10	12	80
Number of kinetosomes of a6	14.66	0.88	0.09	6.00	0.75	14	16	80
Number of kinetosome pairs of the ventral kineties	15.58	0.79	0.08	5.07	0.73	15	17	80
Number of kinetosome pairs of the dorsal kineties	15.33	0.49	0.05	3.19	0.67	15	16	80
Length of the somatic kinetodesmic fiber	1.58	0.01	0.00	0.63	0.63	1.51	1.61	80
Length of the somatic transverse microtubules	0.48	0.01	0.00	2.08	0.84	0.48	0.51	80
Length of the somatic postciliary microtubules	0.67	0.02	0.00	31.34	0.84	0.66	0.72	80

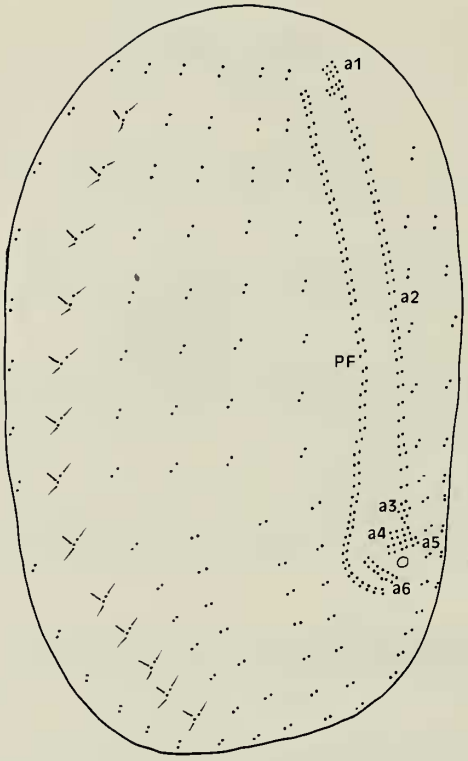
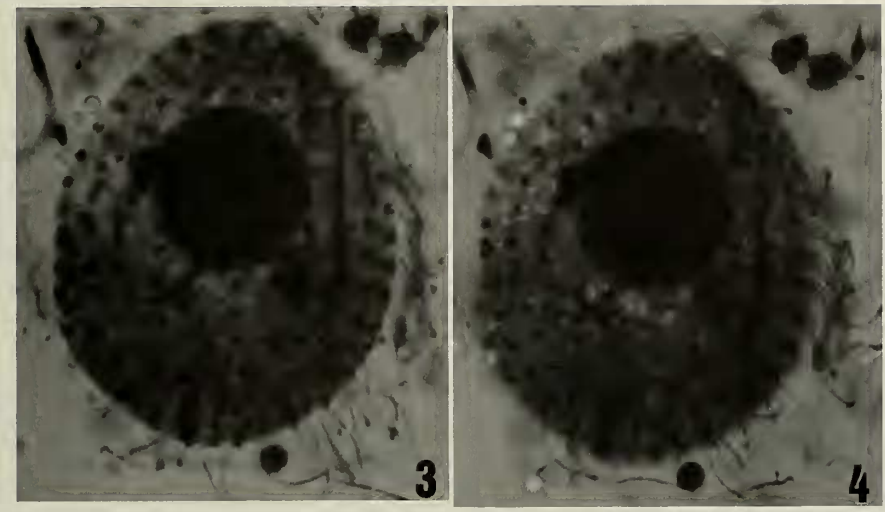


Fig. 2. *Pseudocohnilembus fluviatilis.* Ventral side. PF: paroral formation or outer membrane. a1, a2, a3, a4, a5 and a6: the different elements of the inner membrane.

double row of kinetosomes made up of a linear portion of 30 kinetosomes accompanied in its anterior part by a group of 6–8 kinetosomes. *a2* is about 10 μm long. 3) Slightly separated from *a2, a3* is a triangular group of 5–6 kinetosomes, about 1.1 μm × 0.7 μm in size. Behind *a3,* there are two polykinetids running more or less transversally to the anterio-posterior axis of the ciliate. The more anterior, *a4,* has a length of about 3.4 μm and a width of about 1.1 μm and is made up of 8–10 kinetosomes in two rows. The more posterior, *a5,* is just anterior to the cytosome and is slightly larger than *a4*: about 4.2 μm in length × about 1.2 μm in width. It has 10–12 kinetosomes in two rows. Posterior to the cytostome and parallel to the posterior portion of the paroral, there is a group of 14–16 kinetosomes (*a6*) in two rows, which has a length of 4.2–4.8 μm and a width of about 0.8 μm. In a number of specimens, a pair of kinetosomes were observed posterior to *a6,* and correspond to the scutica (Figs. 2 and 3; Table 1).

Taxonomic position.—These ciliates belong to the class Oligohymenophorea de Puytorac et al. 1974, order Scuticociliatida Small 1967, Family Pseudocohnilembidae Evans & Thompson 1964, genus *Pseudocohnilembus* Evans & Thompson 1964 (Small & Lynn 1985, Corliss 1979, Small 1967, Evans & Thompson 1964). There are 10 species that are most similar to the ciliates studied: *Pseudocohnilembus persalinus* Evans & Thompson 1964; *P. hargisi* Evans & Thompson 1964; *P. longisetus* Evans & Thompson 1964; *P. cantabricus* Fernandez-Leborans & Castro de Zaldumbide 1984; *P. antoniensis* Fernandez-Leborans & Castro de Zaldumbide 1986; *P. portuensis* Fernandez-Leborans & Castro de Zaldumbide 1986; *P. marinus* Thompson 1966 (Foissner & Wilbert 1981); *P. putrinus* Foissner & Wilbert 1981; *P. pusillus* Foissner & Wilbert 1981; *P. caeci* Foissner 1985. These species have been compared with the ciliates studied in the following characteristics: 1, body length; 2, body width; 3, size of macronucleus; 4, number of somatic kineties; 5, number of kinetosomes in each somatic kinety; 6, arrangement of the somatic kinetosomes; 7, derivatives of somatic kinetosomes; 8, size of the oral area; 9, kinetosomal structure of the paroral formation; 10; kinetosomal structure of the inner membrane; and 11, habitat (Table 2). Finding that our specimens (not taking into account the habitat), differ respect *P. persalinus* in 7; *P. hargisi* in 9; *P. longisetus* in 8; *P. cantabricus* in 4; *P. antoniensis* in 7; *P. portuensis* in 7; *P. marinus* in 5; *P. putrinus* in 8; *P. pusillus* in 6; and *P. caeci* in 6 characteristics of the 10 analyzed (Table 2). The size of the body is found in the range of *P. hargisi, P. cantabricus* and *P. marinus.*



Figs. 3–4. 3, *Pseudocohnilembus fluviatilis.* Ventral side, the cilia, nuclear components and infraciliature can be seen (×1640). 4, Dorsal side (×1640).

The macronucleus is similar in size to the *P. cantabricus, P. portuensis* and the *P. caeci.* The kinetosomes of the somatic kineties are grouped in pairs as in *P. antoniensis* and *P. portuensis,* while in *P. marinus, P. putrinus, P. pusillus,* the somatic kinetosomes are only in pairs in a part of the total length of the somatic kinety. The oral area takes up ⅔ of the body length of our specimens as in *P. cantabricus,* while in the other species it only takes up ½ or ⅓ of the body length. Regarding the oral infraciliature there are two diplostichomonads, which are only present in *P. antoniensis,* but while this species only shows a small group of 6–8 kinetosomes near the posterior end of the shortest diplostichomonad (IM), in our specimens there are five groups of kinetosomes, two anterior and two posterior of the IM (inner membrane: kinetosomic structures of the left side of the oral area), and a short double row of kinetosomes near the posterior end of the paroral formation. Taking into account these data, and especially, the number of differences from the other species, the ciliates observed could correspond to a new species, which we have named *Pseudocohnilembus fluviatilis.* On the other hand, and taking into account the variability margins and the principal morphological characteristics, various species described could be put into one group. This is the case of *P. persalinus, P. marinus, P. pusillus, P. longisetus* and *P. putrinus* which have no fundamental differences and could be classified together as *P. persalinus,* the first one to be described. They all have a similar size, number of somatic kineties and structure of oral infraciliature (Table 2).

Note.—Foissner (1985) points out that *P. cantabricus* is a synonym for *P. marinus* redescribed by Foissner & Wilbert (1981). However, we differ in this opinion, above all when we analyze in detail both works (Foissner & Wilbert 1981, Fernandez-Leborans & Castro de Zaldumbide 1984): the redescription by Foissner & Wilbert (1981) is very brief and contains very little biometric data or explanations about the somatic and oral infraciliature of *P. marinus.* But, above all, there are two fundamental features that differentiate the two species. First, the somatic kineties of *P. cantabricus* are each made up of a single row of 20 monokinetids, each one of these has a clearly visible kinetodesmal fibril. In contrast,

Table 2.—Comparison between the species of *Pseudocohnilembus*. (P, pairs; s, single; st, stichomonad; sd, stichodyad; dt, diplostichomonad; Th, Thompson 1966; gk, group of kinetosomes; kd, kinetodesmic fiber; mt, transverse microtubules; mp, postciliar microtubules; m, marine; f, freshwater; s, saline; sl, soil; ec, ectoparasite; bl, body length.)

	P. persalinus	*P. hargisi*	*P. longisetus*	*P. cantabricus*
Length (μm)	30	44	26.6	34.8–40.8
Width (μm)	14	18	11.5	22.8–25.8
Size of the macronucleus (μm)	4.5	4.2–6.7	3.7	13.2–20.4 × 12–17.4
Number of somatic kineties	8–9	14	11	10 (12)
Kinetosomes in each somatic kinety	20	27	16	20
Arrangement of somatic kinetosomes	st	st	st	st
Derivatives of somatic kinetosomes	—	—	—	kd
Size of oral area relative to body length	½ bl	½ bl 21.8	½ bl 12.8	⅔ bl 21–25.2 × 3.6–4.2
Structure of paroral formation (PF)	sd	sd	sd	dt + sd
Structure of the inner membrane	sd (⅘ PF)	sd (=PF)	sd (=PF)	—
Habitat	s	s	m	m

the kineties of *P. marinus* (Foissner & Wilbert 1981) are each made up of dikinetids for the majority of their length. The number of dikinetids in the dorsal kineties, 17–19, makes the total number of kinetosomes in each kinety much greater, 31–35, than in *P. cantabricus*. Second, the oral infraciliature of *P. cantabricus* is composed of one single paroral membrane with two different segments, the anterior one being greater in length, made 39–40 dikinetids, and a posterior segment of 12 dikinetids in zig-zag formation. In *P. marinus* (Foissner & Wilbert 1981), the oral infraciliature is composed of two membranes that show the kinetosomes in zig-zag formation, the shorter (inner membrane) with a posterior kinetosomal group. It is evident taking these differences into account, that we are not dealing with the same species, as Foissner (1985) indicates.

Pseudocohnilembus fluviatilis, new species

Diagnosis.—Rounded, oval in shape, of 33–36 μm in length and 24–27 μm in width. A spherical or oval macronucleus of 12.6–14.4 μm × 10.8–13.7 μm with an adjacent micronucleus of 3–3.8 μm of diameter. Eight ventral kineties and 8–9 somatic dorsal kineties, each with 15–17 dikinetids. The oral area with a paroral formation, which is 16.8–18.5 μm in length with a short polykinetid of two rows near its posterior end and, on the left side, a linear polykinetid (inner membrane) of 14–14.9 μm in length with two small polykinetids anterior and two posterior. Freshwater.

Pleuronema species

General morphology.—Ciliates, oval in appearance, of 70.8–82.8 μm in length and 53.4–60.6 μm in width. A rounded macronucleus is usually located in the anterior half of the body, 15.6–21.2 μm long and 15.9–20.1 μm wide. There are two spherical micronuclei 2.3–2.5 μm in diameter located beside the macronucleus. (Fig. 5; Table 3).

Somatic infraciliature.—There are 29–31 somatic kineties, of which 15–16 are ventral and 14–15 are dorsal. The majority of the kineties are bipolar, except for 6 dorsal kineties and 5–6 ventral kineties. The shortest ventral kineties are found anterior and left of the posterior of the oral area. They have a length of 42–46.8 μm and are made up

Table 2—Extended.

P. antoniensis	*P. portuensis*	*P. marinus*	*P. putrinus*	*P. pusillus*	*P. caeci*	*P. fluviatilis*
12.9–16.5	18.6–24.9	32–36	17–27	25–42	59–105	33–36.2
10–13.5	11.8–17.7	20–22	6.6–14.6	12–26	22–42	24–27
5.8–8.4 × 2.7–4.9	7.2–12.6	10.5–11 × 9.3–10	4–8 × 4–6.6	5–8 × 5–8.1	10–14 × 8–14	12.6–14.4 × 10.8–13.7
10	10	8–9 (10 Th)	10	10–11	10–14	16–17
12–18 p	18–20 p	29–33 p + 5–8 s	14–17 p + s	15–23 p + s	33–46 p + s	15–17 p
sd	sd	sd + st (st Th)	sd + st	sd + st	sd + st	sd
kd	kd, mt, mp	—	—	—	—	kd, mt, mp
½ bl	½ bl	½ bl	½ bl	½ bl	⅓ bl	⅔ bl
9.15–11.4						
dt	st + sd	sd + gk (st Th)	sd	sd	sd + st	dt + dt
dt + 6–8 k	—	sd (st Th)	sd	sd	sd + st	2 gk + dt + 3 gk
m	m	f (m Th)	sl	f	m (ec)	f

of 22–26 dikinetids. The shortest dorsal kineties are found between the anterior pole and an area in the left posterior region where various kineties converge in a "V" shaped suture. In the center of this area, there are two parallel kineties (4 and 5) (somatic kinety 1 is situated on the right of the oral infraciliature) of 53.1–54 μm in length and 38–40 dikinetids each. Lateral to these two kineties another two are found (3 and 6) that converge beneath the posterior end of the previous two; they have 42–44 dikinetids each. Lateral to these last two kineties (3 and 6) are another two (7 and 2) that also converge posteriorly and have 46–48 dikinetids each. The remaining somatic kineties have 50–54 dikinetids each. In each pair of somatic kinetosomes, the one on the right has a thick derivative that runs from the kinetosome to the right anterior area of the ciliate (kinetodesmal fiber) and is 1.8–3 μm long. There is a fibrillar net that circles and accompanies the pairs of somatic kinetosomes (Figs. 6–9; Table 3).

The oral infraciliature.—The oral area takes up a large part (51–57 μm) of the total length of the individual and is composed of three kinetosomal structures: 1) the paroral formation (PF); 2) membrane 1 (M1) and 3) the pericytostomal structures (oral formation, OF).

The paroral formation (PF) has a length of 39.6–45 μm and is longitudinally located on the left side of the oral area. The anterior end of this structure is 21.3–23.2 μm from he anterior pole and is 60.6–62.8 μm from the posterior pole. The posterior end of the paroral is found near the anterior area of the oral formation (OF). This structure is made up of 140–144 dikinetids. Accompanying the paroral formation there is a fiber that runs parallel to this structure for its whole length and extends posteriorly, having a length of 45–50.4 μm (subparoral fiber, SPF). Paroral dikinetids connect by means of fine prolongations (a) with the subparoral fiber.

M1 is found near the anterior end of the paroral formation with its posterior end slightly separated from this structure. It is 5.94–8.4 μm and is made up of 24–38 kinetosomes grouped in pairs (12–19 dikinetids).

The oral formation (OF) is in the posterior oral area, encircling the cytostome. This structure is divided into two parts: one longer one made up of a single row of 60–70 kinetosomes (stichomonad), M2, and an-

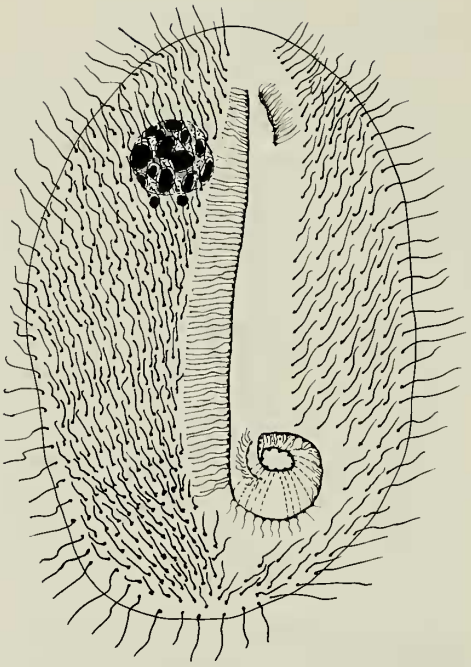


Fig. 5. General view of *Pleuronema ovata* showing the cilia and nuclear components.

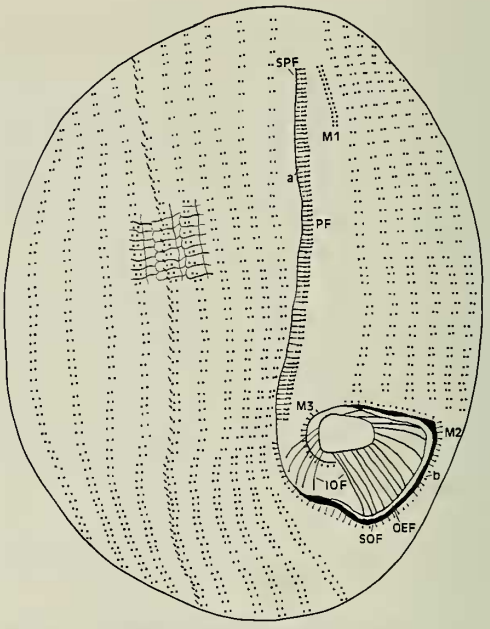


Fig. 6. *Pleuronema ovata.* Ventral side. SPF: subparoral fiber; a: fibrillar connections between the paroral formation (PF) and the SPF; IOF: intermediate oral fibers; OEF: oral external fiber; b: fibrillar connections between the OEF and the M2; SOF: suboral fiber.

other shorter one separated of the anterior for a zone without kinetosomes, found on top of the corresponding cytostome area, and made up of a single row (stichomonad) of 12–16 kinetosomes (M3). Parallel to the oral formation is a thick fibrous structure called the *suboral fiber* (SOF), which forms fine connections (b) with each of the kinetosomes of the oral formation. The suboral fiber is 45–48.6 μm long and connects up with the subparoral fiber.

The oral formation circles a fibrous group (ribbed field, Small, 1967) that is constituted of various structures. First, a closed fibrillar structure, more or less circular, immediately defines the entrance to the cytostome, and is called oral inner fiber (OIF). It is 3.4–5.2 μm in length. Second, an open fibrillar structure, the external oral fiber (OEF), runs parallel to and accompanies the suboral fiber along part of its length. It is 36.8–38.5 μm long. Third, between the oral inner fiber and the external oral fiber there is a group of fibers called intermediate oral fibers (IOF). Some of these fibers (4–6) are connected to an oral inner fiber by one end while the other end remains free in the oral cavity; these fibers measure 1.8–3.6 μm. The remaining fibers (10–14) have as much connection with the oral internal fiber as with the external oral fiber, and are 9–12 μm long (Figs. 6 and 8; Table 3).

Taxonomic position. —The specimens studied belong to class Oligohymenophorea De Puytorac et al. 1974, order Scuticociliatida Small 1967, suborder Pleuronematina Fauré-Fremiet in Corliss 1956, family Pleuronematidae Kent 1881, genus *Pleuronema* Dujardin 1836 (Small & Lynn 1985; Corliss 1979; Small 1967; Grolière & Detcheva 1974; Small & Antipa 1978; Dragesco 1960, 1968; Dragesco & Dragesco-Kernéis 1986; Agamaliev 1983). The structural simplicity of the oral infraciliature of these individuals

Table 3.—Biometric data of *Pleuronema ovata*.

	Arithmetic mean	Standard deviation	Standard error	Coefficient of variation	Pearson coefficient	Minimum	Maximum	Observations
Length	77.3	3.05	0.34	3.94	−0.22	70.8	82.8	80
Width	56.26	1.93	0.21	3.43	0.65	53.4	60.6	80
Length of the macronucleus	18.46	1.56	0.17	8.45	0.29	15.6	21.24	80
Width of the macronucleus	18.18	1.15	0.12	6.32	0.67	15.9	20.16	80
Diameter of the micronuclei	2.41	0.05	0.00	2.07	0.20	2.34	2.52	80
Length of paroral formation	43.15	1.27	0.14	2.94	0.11	39.6	45	80
Length of the M1	7.09	0.61	0.06	8.60	−0.50	5.94	8.4	80
Length of the oral internal fiber zone	4.55	0.60	0.06	13.18	−0.41	3.4	5.2	80
Width of the oral internal fiber zone	5.19	0.82	0.09	12.90	−1.02	4.1	6.3	80
Length of the oral external fiber	37.68	0.57	0.06	1.51	−0.21	36.8	38.5	80
Number of kinetosomes of M1	29.87	4.51	0.50	15.09	0.85	24	38	80
Number of kinetosomes of paroral formation	142	1.34	0.14	0.94	0.00	140	144	80
Number of kinetosomes of the oral formation	78.91	1.62	0.18	2.05	−0.05	76	82	80
Length of subparoral fiber	47.06	1.29	0.14	2.74	0.04	45	50.4	80
Numer of somatic kineties	30	0.60	0.06	2	0	29	31	80
Length of suboral fiber	46.96	1.12	0.12	2.38	0.85	45	48.6	80
Number of kinetosome pairs of each ventral kinety	55.16	1.69	0.18	3.06	0.09	52	58	80
Kinetosome pairs of dorsal kineties 4 and 5	38.91	0.66	0.07	1.69	−0.13	38	40	80
Length of dorsal kineties 4 and 5	53.67	0.31	0.03	0.57	0.87	53.1	54	80
Kinetosome pairs of dorsal kineties 3 and 6	43	0.73	0.08	1.69	0.00	42	44	80
Kinetosome pairs of dorsal kineties 2 and 7	46.83	0.71	0.07	1.51	−0.23	46	48	80
Kinetosome pairs of the rest of dorsal kineties	52.33	1.15	0.12	2.19	0.28	50	54	80
Distance anterior end of paroral formation–anterior pole	22.42	0.53	0.05	2.36	0.03	21.3	23.2	80
Distance anterior end of paroral formation–posterior pole	61.59	0.63	0.07	1.02	−0.33	60.6	62.8	80
Distance anterior end of oral internal fiber–anterior pole	49.38	1.14	0.12	2.30	0.15	47.6	52.2	80
Distance posterior end of oral internal fiber–anterior pole	30.44	0.93	0.10	3.05	−0.17	28.6	32.1	80
Distance anterior end of oral formation–anterior pole	48.85	1.13	0.12	2.31	0.22	46.8	51	80
Distance posterior end of oral formation–posterior pole	16.78	0.93	0.10	5.54	0.62	15.1	18.3	80

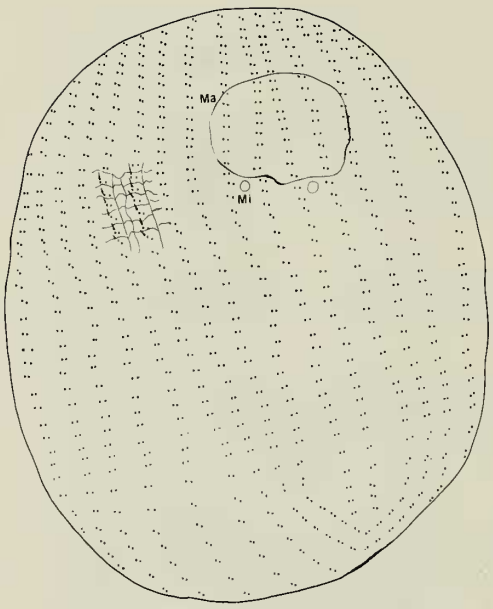
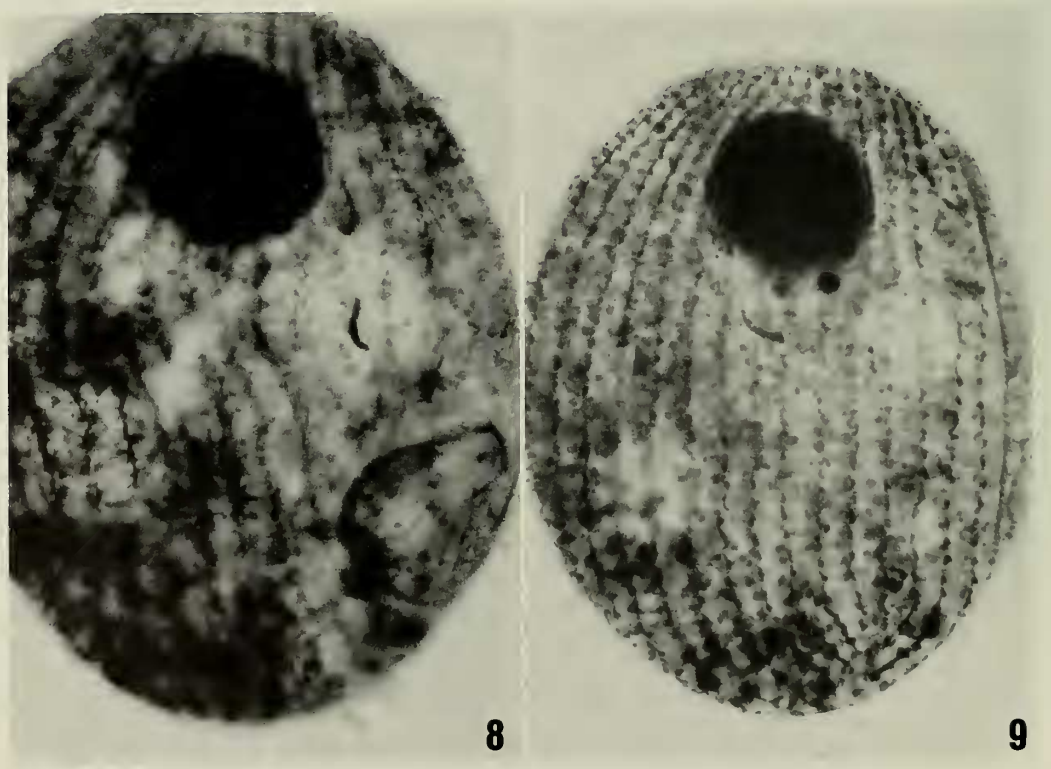


Fig. 7. *Pleuronema ovata.* Dorsal side showing the nuclear arrangement and the "V" area near the posterior end of the ciliate.

makes it unnecessary to compare, from biometric point of view, this *Pleuronema* species with those previously described, which undoubtedly have a greater kinetosomal complexity, particularly in the posterior zone of the oral area. Taking into account the published data (indicated above), these ciliates can be placed in the *Pleuronema simplex* species (Dragesco 1960), which is the one that shows a greater reduction of the oral infraciliature. However, our specimens lack the posterior segment of M2 (Dragesco & Dragesco-Kernéis 1986), although it is somewhat reduced in *Pleuronema simplex.* Furthermore, this species is from a marine habitat, while the Spanish population is from freshwater. Thus, a new species is proposed, *Pleuronema ovata.*

Pleuronema ovata, new species

Diagnosis.—Oval-shaped ciliates, 70.8–82.8 μm long and 53.4–60.6 μm wide.



Figs. 8–9. *Pleuronema ovata.* 8, Ventral side of a stained specimen (×1510). 9, Dorsal side (×1360).

Spherical macronucleus of 15.6–21.2 μm × 15.9–20.1 μm in size, with two adjacent micronuclei of 2.3–2.5 μm in diameter. The oral area is of 51–57 μm in length with a infraciliature reduced to a paroral, an anterior membrane M1, and two membranoid segments M2 and M3 (stichomonads). Fifteen–16 ventral kineties, 6 of which converge in a "V" zone located anterior to the posterior pole. Freshwater.

Although the oral region of *Pleuronema* is situated laterally, we call the zone that includes the oral region "ventral" and the opposite "dorsal" to make this description correspond to those of other scuticociliates. The pericytostomal structures have traditionally been included in the paroral formation, but their kinetosomic composition is different from that of the latter, and they include two zones, M2 and M3 (stichomonads), separated by an area without kinetosomes. The fibrillar components of the pericytostomal structures are also different from those of the paroral formation.

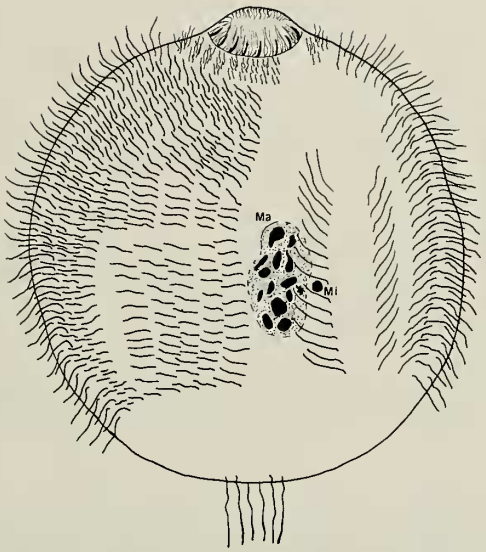


Fig. 10. General view of *Urotricha rotunda* showing the cilia and the nuclear components.

Urotricha species

General morphology.—Ciliates, rounded oval in appearance, 48–55.2 μm in length, and 45–48 μm in width. They have an oral opening located in the anterior pole of the individual, which is 2.9–3.6 μm long and 2.2–3.2 μm wide. The oval macronucleus is 19.2–22.2 μm long and 13.2–15.4 μm wide. The micronucleus, is located beside the macronucleus, and is spherical with a diameter of 4.8–6 μm. The contractile vacuole pore is located half-way along the body between the kineties 12 and 13, and is 31.2–32.4 μm from the anterior pole and 21.6–22.4 μm from the posterior pole of the ciliate (Fig. 10; Table 4).

Somatic infraciliature.—There are 45–48 somatic kineties that run between the area near the oral opening and a posterior zone without kinetosomes. Three of these kineties are shorter than the rest as they abut on the brush. The posterior end, where the somatic kineties are broken off, is 40.8–42 μm from the anterior pole and 14.6–15.2 μm from the posterior pole. Each somatic kinety has 30–36 pairs of kinetosomes. The number of pairs of kinetosomes is slightly less on the dorsal side than on the ventral: 30–32 vs. 33–36. The 3–4 most anterior pairs of each kinety are more closely grouped forming a border 1.8–2.4 μm wide. Each pair of somatic kinetosomes has three derivatives: the two associated with the right kinetosome are kinetodesmal fibril and postciliary microtubules, and those associated with the left kinetosome are transverse microtubules.

In the posterior area of the ciliate there are 6–8 groups of 2–4 kinetosomes each. The kinetosomes of each group appear connected to each other by means of a fibrous structures, in such a way that each group as a whole, has a circular appearance. These caudal kinetosomal groups (CKG) give use to the caudal cilia (Figs. 11–13; Table 4).

Oral infraciliature.—This is made up of two structures: the perioral formation (PF) and the adoral organellar complexes (brush).

The perioral formation (PFO) consists of

Table 4.—Biometric data of *Urotricha rotunda*.

	Arithmetic mean	Standard deviation	Standard error	Coefficient of variation	Pearson coefficient	Minimum	Maximum	Observations
Length	51.84	1.76	0.19	3.39	0.48	48.00	55.20	80
Width	46.87	0.82	0.09	1.74	0.45	45.00	48.00	80
Length of the oral opening	3.18	0.22	0.02	6.91	0.36	2.94	3.60	80
Width of the oral opening	2.71	0.24	0.02	8.85	0.45	2.16	3.20	80
Length of the perioral formation zone	11.05	0.15	0.01	1.35	0.33	10.80	11.40	80
Width of the perioral formation zone	7.30	0.31	0.03	4.40	0.09	6.60	7.80	80
Length of the fibrillar bundles of the perioral formation	1.36	0.08	0.00	6.17	0.75	1.26	1.50	80
Length of the macronucleus	20.49	0.83	0.09	4.05	0.59	19.20	22.20	80
Width of the macronucleus	14.35	0.62	0.06	4.32	0.56	13.20	15.40	80
Diameter of the micronucleus	5.31	0.35	0.03	6.59	0.31	4.80	6.00	80
Length of B1	3.05	0.19	0.02	6.22	−0.26	2.64	3.30	80
Length of B2	1.99	0.18	0.02	9.04	−0.05	1.68	2.26	80
Length of B3	1.65	0.18	0.02	10.90	0.27	1.20	1.90	80
Number of kinetosomes of B1	8.37	1.02	0.11	12.18	0.36	7.00	10.00	80
Number of kinetosomes of B2	6.25	0.45	0.05	7.20	0.55	6.00	7.00	80
Number of kinetosomes of B3	3.41	0.51	0.05	14.95	0.80	3.00	4.00	80
Number of fibrillar bundles of perioral formation	23.00	0.60	0.06	2.60	0.00	22.00	24.00	80
Number of caudal kinetosomal groups	6.91	0.66	0.07	9.55	−0.13	6.00	8.00	80
No. kinetosomes of each caudal kinetosomal group	3.00	0.60	0.06	20.00	0.00	2.00	4.00	80
Number of ventral kineties	23.83	0.83	0.09	3.48	0.99	23.00	25.00	80
Number of dorsal kineties	22.25	0.45	0.05	2.02	0.55	22.00	23.00	80
No. kinetosome pairs of anterior segment of somatic kineties	3.16	0.38	0.04	12.02	0.42	3.00	4.00	80
Length of the anterior segment of the somatic kineties	2.00	0.17	0.01	8.50	0.58	1.80	2.40	80
Number of kinetosome pairs in each ventral kinety	34.08	0.99	0.11	2.90	0.08	33.00	36.00	80
Number of kinetosome pairs in each dorsal kinety	31.41	0.79	0.08	2.51	−0.74	30.00	32.00	80
Distance posterior end of somatic kineties–anterior pole	41.21	0.29	0.03	0.70	0.03	40.80	42.00	80
Distance posterior end of somatic kineties–posterior pole	14.82	0.19	0.02	1.28	0.10	14.60	15.20	80
Distance B1–anterior pole	11.15	0.29	0.03	2.60	0.51	10.80	11.90	80
Distance B1–posterior pole	49.30	0.64	0.07	1.29	0.15	48.10	50.80	80
Distance B2–anterior pole	13.43	0.40	0.04	2.97	0.57	13.00	14.40	80
Distance B2–posterior pole	47.92	0.59	0.06	1.23	−0.13	47.00	49.00	80
Distance B3–anterior pole	15.75	0.69	0.07	4.38	0.79	15.00	17.10	80
Distance B3–posterior pole	47.20	0.33	0.03	0.69	0.00	46.80	47.90	80
Length of each caudal kinetosomal group	1.60	0.03	0.00	1.87	0.66	1.56	1.68	80
Width of each caudal kinetosomal group	1.20	0.01	0.00	0.83	0.08	1.16	1.23	80
Distance pore of contractile vacuole–anterior pole	31.92	0.28	0.03	0.87	0.42	31.20	32.40	80
Distance pore of contractile vacuole–posterior pole	22.02	0.22	0.02	0.99	0.11	21.60	22.40	80

a crown of 22–24 pairs of kinetosomes that circle the oral opening. From each of these pairs of kinetosomes and towards the buccal opening, there is a fibrous bundle of 1.3–1.5 μm long. The perioral formation as a whole is 10.8–11.4 μm long and 6.6–7.8 μm wide.

There are three adoral organellar complexes (brush kineties) (B1, B2 and B3) running more or less meridionally from the anterior part of the ciliate to its equatorial zone. B1 is the most anterior, 10.8–11.9 μm from the anterior pole and 48.1–50.8 μm from the posterior pole of the ciliate; it is 2.6–3.3 μm long and is made up of two rows that have a total of 7–10 kinetosomes. B2 is 13–14.4 μm from the anterior pole, and 47–49 μm from the posterior pole of the individual; it is 1.7–2.3 μm long and is made up of 6–7 kinetosomes grouped in two rows. B3, the most posterior, is 15–17.1 μm from the anterior pole and 46.8–47.9 μm from the posterior pole of the ciliate; it is 1.2–1.9 μm long and has 3–4 kinetosomes (Figs. 11 and 12; Table 4).

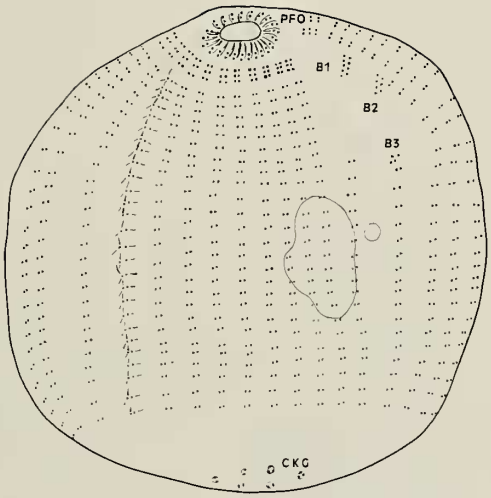


Fig. 11. *Urotricha rotunda.* PFO: perioral formation; B1, B2 and B3: brush kineties; CKG: caudal kinetosomic groups.

Taxonomic position. —The specimens studied belong to the class Prostomatea Schewiakoff 1896, order Prorodontida Corliss 1974, Family Urotrichidae Small &

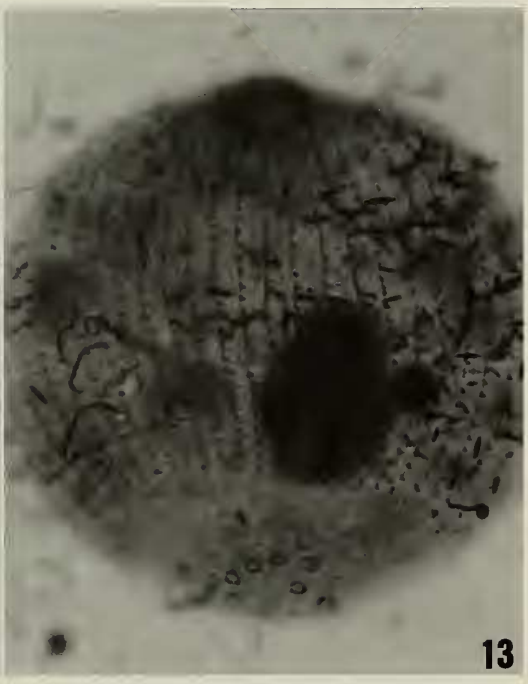


Fig. 12–13. 12, *Urotricha rotunda.* The ventral side of a stained specimen (×1800). 13, *Urotricha rotunda.* Dorsal surface. The caudal kinetosomic groups can be observed (×1800).

Table 5.—Comparison between species of *Urotricha* genus. (ov, oval; el, elongated; sr, spheric; p, pairs; Kh, Kahl 1935; s, single; cd, double corone).

	U. castalia	*U. puytoraci*	*U. sphaerica*	*U. apsher-onica*	*U. pelagica*	*U. armata*	*U. ovata*	*U. macro-stoma*	*U. agilis*	*U. ondina*	*U. armata*(*)
Length	44–67	50–60	48–55	75	50–65	47–55 Kh 31–42	25–45 Kh 25–40	30–40	10–20	19–40	80
Width	39–65	—	46–51	55–60	38–50	24–32	20–38	—	—	16–35	—
Length and shape of the macro-nucleus	11–19sr	el	10–15 ov	18 ov	sr	7–11 sr 17 el Kh	sr	sr			
Width of the macronucleus	—	—	—	—	—	7.5–11	—	—	sr	9 sr	sr
Distance posterior end of adoral organellar zone–anterior pole	—	—	—	—	—	8–15	—	—	—	—	—
Distance posterior end of adoral organellar zone–posterior pole	—	—	—	—	—	25–36	—	—	—	—	—
B1: length/number of rows/ number of kinetosomes	–/2/10–18	—	—	—	—	2.8–3/3/–	1.5–2/–/–	—	—	—	—
B2: length/number of rows/ number of kinetosomes	–/2/8–12	—	—	—	—	2.8–3/3/–	1.5–2/–/–	—	—	—/2/6–8	—
B3: length/number of rows/ number of kinetosomes	–/2/6–12	—	—	—	—	2.8–3/3/–	1.5–2/–/–	—	—	—/2/5–6	—
Number of somatic kineties	45–50	48–51	59–61	60	45–50	35–41 60–67 Kh	19–24	—	—	—/2/3–4	—
Number of kinetosomes of each somatic kinety	16–18	—	—	—	—	20–30	—	24–26	12–14	23–26	—
Number of caudal cilia	5–7	s	1	18	10	1 Kh	1	—	—	9–16	—
Number of caudal kinetosomic group (number of kineto-somes in each group)	1	—	1(1)	18(1)	—	1(1)	1(1)	2	1	1	5–7
Number of kinetosomes in the perioral formation	23–25 p	26–27 p	26 p	30–35 p	cd	15–20 p 27–30 p Kh	10 p 30 p Kh	—	—	1	—
Number of short somatic kineties	5–7	5	2	5	3	3(6 Kh)	2	13 p	—	12–16 p	—
Number of adoral organelles (brush)	3	3	3	3	3	3(6 Kh)	3	3	—	3	—

Table 5.—Continued.

	U. satrophila	*U. vitrea*	*U. nais*	*U. venatrix*	*U. farcta*	*U. faurei*	*U. baltica*	*U. rotunda*	*U. corlissiana*	*U. valida*
Length	20	27–47	16–34	66	19–32	35–46	65–80	48–55.2	25–33	52–63
Width	45	26–44	12–32	—	—	—	—	45–48	17–22	43–55
Length and shape of the macronucleus	ov	sr	8–11 ov	17 el	sr	14–22 sr	—	19–22 ov	7–10 ov	26–33 ov
Width of the macronucleus	—	—	—	—	—	—	—	13.2–15.4	6–8	12–16
Distance posterior end of adoral organellar zone–anterior pole	—	—		—	—	—	—	15–17.1	—	—
Distance posterior end of adoral organellar zone–posterior pole	—	—	—	—	—	—	—	40.8–42		
B1: length/number of rows/ number of kinetosomes	−/2/6	−/2/8	−/2/8	—	—	—	—	2.6–3.3/3/7–10	—	−/2/−
B2: length/number of rows/ number of kinetosomes	−/2/6	−/2/6	−/2/4	—	—	—	—	1.6–2.2/2/6–7	—	−/2/−
B3: length/number of rows/ number of kinetosomes	−/2/6(13)	−/2/4	—	—	—	—	—	1.2–1.9/2/3–4	—	−/2/−
Number of somatic kineties	23–25	20–23	18–21	65–70	28–30	55–60	32–36	45–48	42–51	76–87
Number of kinetosomes of each somatic kinety	11–16	15–20	5–11	—	—	—	—	30–36	—	—
Number of caudal cilia	3	1	1	10–15	1	12–15	—	12–32	1	10–14
Number of caudal kinetosomic group (number of kinetosomes in each group)	1	1(2)	1(2)	—	—	—	—	6–8(2–4)	1	—
Number of kinetosomes in the perioral formation	23–25 p	13–16 p	9–10 p	—	13–14 s, p	12 p	25 p	22–24 p	16 p	50 p
Number of short somatic kineties	0	3	1	4	—	4	—	3	—	—
Number of adoral organelles (brush)	13	3	2	3	3–4	4	3	3	3	3

Lynn 1985, and genus *Urotricha* Claparède & Lachmann 1895. The best-known species of this genus are: *Urotricha castalia* Muñoz et al. 1987; *U. puytoraci* Dragesco et al. 1974; *U. sphaerica* Grolière 1977; *U. apsheronica* Alekperov 1983; *U. pelagica* Wilbert 1986; *U. armata* Kahl 1927 (Foissner 1984); *U. ovata* Kahl 1926 (Foissner 1979); *U. macrostoma* Foissner 1983; *U. agilis* Stokes 1886 (Foissner 1979); *U. ondina* Muñoz et al. 1989; *U. armata* Kahl 1927 (Dragesco 1960); *U. satrophila* Kahl 1935 (Pätsch 1974); *U. vitrea* Martin-Gonzalez et al. 1985; *U. nais* Muñoz et al. 1987; *U. venatrix* Kahl 1935; *U. farcta* Dragesco et al. 1974; *U. faurei* Dragesco et al. 1974; *U. baltica* Czapik & Jordan 1976; *U. corlissiana* Song & Wilbert 1989, and *U. valida* Song & Wilbert 1989. The species that permit a more detailed comparison, due to the fact that there is more biometric data available, are A, *U. castalia,* F, *U. armata,* G, *U. ovata,* J, *U. ondina,* L, *U. satrophila,* M, *U. vitrea,* N, *U. nais.* With respect to these 7 species, our specimens differ from *U. castalia* in 10; *U. armata* in 15; *U. ovata* in 10; *U. ondina* in 11; *U. satrophila* in 10; *U. vitrea* in 10 and from *U. nais* in 13 of the 16 characteristics it has been possible to consider: 1, body length; 2, body width; 3, length of the macronucleus; 4, width of the macronucleus; 5, distance between the posterior end of the adoral organelles (brush) and the anterior pole; 6, distance between the posterior end of the adoral organelles (brush) and the posterior pole; 7, B1 length/number of kineties/number of kinetosomes; 8, B2 length/number of kineties/number of kinetosomes; 9, B3 length/number of kineties/number of kinetosomes; 10, number of somatic kineties; 11, number of kinetosomes of the somatic kineties; 12, number of caudal cilia; 13, number of caudal kinetosomal groups (CKG); 14, number of kinetosomes of the perioral formation (circumoral corone); 15, number of short somatic kineties; and 16, number of adoral organelles (brush). With regard to the ciliates studied, the length of the body is greater in *U. apsheronica, U. armata* (Dragesco 1960), *U. venatrix* and *U. baltica.* The body is shorter in *U. ovata, U. macrostoma, U. agilis, U. ondina, U. satrophila, U. vitrea, U. nais, U. farcta, U. faurei* and *U. corlissiana,* being similar in the rest of the species. The number of somatic kineties is higher in *U. sphaerica, U. apsheronica, U. venatrix, U. faurei* and *U. valida,* and lower in *U. armata, U. ovata, U. macrostoma, U. agilis, U. ondina, U. satrophila, U. vitrea, U. nais, U. farcta* and *U. baltica.* The number of caudal cilia is similar in *U. apsheronica, U. venatrix, U. faurei* and *U. valida,* being lower in the rest of the species. The number of kinetosomes in the perioral formation is higher in *U. puytoraci, U. sphaerica, U. apsheronica* and *U. valida,* and lower in *U. armata, U. ovata, U. macrostoma, U. ondina, U. vitrea, U. nais, U. farcta, U. faurei* and *U. corlissiana.* Due to these various differences, we conclude that our specimens represent a new species, *Urotricha rotunda* (Table 5).

Urotricha rotunda, new species

Diagnosis.—Ciliates, round or oval in appearance, 48–55.2 μm long and 45–48 μm wide. Oval macronucleus (19.2–22.2 μm × 13.2–15.4 μm in size) with an adjacent spherical micronucleus 4.8–6 μm in diameter. 45–48 somatic kineties broken off in the posterior zone of the body, with 30–36 pairs of kinetosomes each. 6–8 caudal kinetosomal groups. Perioral formation of 22–24 pairs of kinetosomes.

Type specimens: permanent slides stained with silver carbonate technique, deposited in the Laboratorio de Biología General, Departamento de Biología Animal I (Zoología), Facultad de Biología, Universidad Complutense, ref. n. 2314 a–f (*Pseudocohnilembus fluviatilis*), ref. no. 3126 a–g (*Pleuronema ovata*), ref. no. 2788 a–l (*Urotricha rotunda*).

Acknowledgments

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